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Effects of Gestational Diabetes Mellitus on Offspring's Neurobehavioral Development: A Retrospective Cohort Study

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Abstract: *Objective:* To evaluate the association between gestational diabetes mellitus (GDM) and offspring neurobehavioral development. *Methods:* A total of 280 infants born to mothers with or without GDM were recruited, and their neurobehavioral development was assessed using the Children's Neuropsychological and Behavioral Scale (CNBS). *Results:* Infants born to mothers with GDM exhibited significantly lower development quotient (DQ) scores at the 1st, 3rd, 6th, 8th, and 12th months after birth. *Conclusion:* GDM may adversely affect offspring neurobehavioral development, with this effect persisting despite interventions implemented during pregnancy.

Keywords: Gestational diabetes mellitus; Development quotient

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1. Introduction

Gestational diabetes mellitus (GDM) is a prevalent complication of pregnancy characterized by abnormal glucose tolerance first detected or occurring during gestation [1]. The incidence of GDM has surged in recent decades, attributed to lifestyle changes and the increasing prevalence of overweight individuals. Apart from elevating the risks of other pregnancy complications and adverse birth outcomes, GDM's potential impact on offspring neurodevelopment has drawn attention. However, existing data on this matter are not entirely consistent. Therefore, further elucidating the effects of GDM on offspring neurobehavioral development is warranted.

2. Methods

A total of 140 subjects (mothers with GDM or normal glucose tolerance and their newborns) met the following criteria: (1) maternal age between 18 and 40 years; (2) delivery occurring between 37 and 41 weeks of gestation; (3) singleton birth. Subjects were excluded if they had: (1) type I or II diabetes mellitus before pregnancy; (2) GDM requiring medication or insulin treatment; (3) severe acute or chronic infectious diseases

or any other pregnancy complications.

GDM was diagnosed by medical professionals at the hospital using a one-step strategy of a 75-g oral glucose tolerance test (OGTT) conducted at 24–28 weeks of gestation, following the Classification and Diagnosis of Diabetes issued by the American Diabetes Association (ADA) in 2016. Upon diagnosis of GDM, interventions were implemented according to the Clinical Management Guidelines for Obstetrician–Gynecologists. Children's Neuropsychological and Behavioral Scale (CNBS) scores as well as maternal and neonatal information were collected from hospital records.

The data were summarized as mean ± standard deviation (SD) and percentages, depending on the nature of the variables involved, and analyzed using SPSS 20.0. A significance level of $P < 0.05$ was considered statistically significant.

3. Results

The characteristics of the participants showed that the GDM women had significantly older maternal ages and a higher BMI compared with their controls (**Table 1**).

Table 1. Characteristics of study populations

		Control (n = 140)	GDM (n = 140)	t/χ^2	P
Maternal					
	Age (years, mean ± SD)	28.69 ± 4.50	30.07 ± 4.92	0.28	0.015
	Pregnancy BMI (kg/m^2, mean ± SD)	27.86 ± 3.45	29.59 ± 4.10	3.82	< 0.001
	Gestational age (weeks, mean ± SD)	38.79 ± 0.88	38.71 ± 0.95	-0.79	0.433
	Parity [n (%)]				
	1	78 (55.7)	85 (60.7)	0.72	0.467
	2	62 (44.3)	55 (39.3)		
	Nationality [n (%)]				
	Han	95 (67.9)	89 (63.6)	7.2	0.056
	Manchu	36 (25.7)	45 (32.1)		
	Mongol	9 (6.4)	3 (2.1)		
	Others	0 (0.0)	3 (2.1)		
Newborn					
	Gender [n (%)]				
	Boy	73 (52.1)	82 (58.6)	1.17	0.336
	Girl	67 (47.9)	58 (41.4)		
	Birth weight (kg, mean ± SD)	3.37 ± 0.47	3.39 ± 0.47	0.28	0.781
	Birth height (cm, mean ± SD)	50.89 ± 1.49	50.69 ± 1.60	-1.08	0.281

Abbreviation: GDM, gestational diabetes mellitus; SD, standard deviation; n, the number of samples.

The development quotient (DQ) scores of the GDM children were significantly lower than that of the controls in the 1st (95.14 ± 5.93 vs. 97.14 ± 6.73, $P = 0.009$), 3rd (89.81 ± 6.34 vs. 94.34 ± 6.50, $P = 0.001$), 6th (94.79 ± 5.63 vs. 97.12 ± 6.31, $P = 0.001$), 8th (96.95 ± 3.07 vs. 97.72 ± 3.05, $P = 0.037$), and 12th months (97.96 ± 2.80 vs. 98.92 ± 3.03, $P = 0.007$) after birth.

4. Discussion

This study investigated the impact of GDM on offspring neurobehavioral development by assessing DQ scores. The findings revealed that children born to mothers with GDM exhibited significantly reduced DQ scores from the 1st to the 12th month, despite interventions such as modified diets and physical activities implemented upon GDM diagnosis.

Previous research has indicated that elevated glucose levels can hinder the transfer of essential fatty acids like arachidonic acid (ARA) and docosahexaenoic acid (DHA) from maternal circulation to fetuses, potentially affecting offspring's cognitive function [2]. Additionally, GDM women often experience placental vascular diseases, leading to thickening of the placental vascular wall and narrowing of the vascular lumen. This condition may induce fetal intrauterine ischemia and anoxia [3,4], thereby contributing to developmental retardation in the fetal brain [5,6].

The study's strengths include the utilization of DQ scores to assess neurobehavioral development up to the 12th month, as well as the exclusion of GDM patients with other complications requiring medication or insulin treatment, thus minimizing confounding factors in fetal and infant development.

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Disclosure statement

The authors declare no conflict of interest.

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